Title – Development of Composite Materials with Embedded Structural Health Monitoring Systems

Program of Study – Mechanical Engineering

Presentation Type – Physical Poster

Subtype – Theoretical Abstract

Mentor(s) and Mentor Email – Dr. Ephraim Zegeye (ezegeye@liberty.edu)

Student name(s) and email(s) – Jacob McMunn (jdmcmunn@liberty.edu)

This poster presentation presents an innovative method for the manufacturing of organic composite materials with embedded Structural Health Monitoring systems, also known as SHM, through additive manufacturing. An SHM system is an array of electronic sensors used to measure changes in voltage resistance when the material is placed under load, identifying anomaly areas such as stress concentrations and fracture points within the material. The research presented forth provides testing of a proposed material compilation to produce SHM material and evaluate its performance for future industrial deployment. A total of ten tensile specimens are manufactured using a combination of additive manufacturing and partial-injection molding to produce organic resin composite material specimens, half of which are formed without embedded sensing material to test material integrity with changes to composition. The specimens are formed from Epoxy 635 resin with a medium Epoxy Hardener (US Composites) forming the composite host. The sensory material utilizes the identical polymer composite mixed with a predetermined weight ratio of 12% weight of exfoliated graphite platelets to allow conductivity through them. Once constructed, tensile testing of the samples is conducted to determine the quality of the design. The results of the testing have not yet commenced, but they will commence during the week of March 11th through the 15th. The results will be compiled and then analyzed for final evaluation. With the final testing results

needing to be completed at this point, the full extent of this technologies is not yet known. However, as for the fabrication method itself, the process has so far proven to be of sound and promising results. The upsides to the additive manufacturing techniques and partial-embedding methods have so far outweighed the faults of the design.

References

US Composites. (n.d.). Retrieved February 27, 2019, from http://www.uscomposites.com/epoxy.html#epoxhard